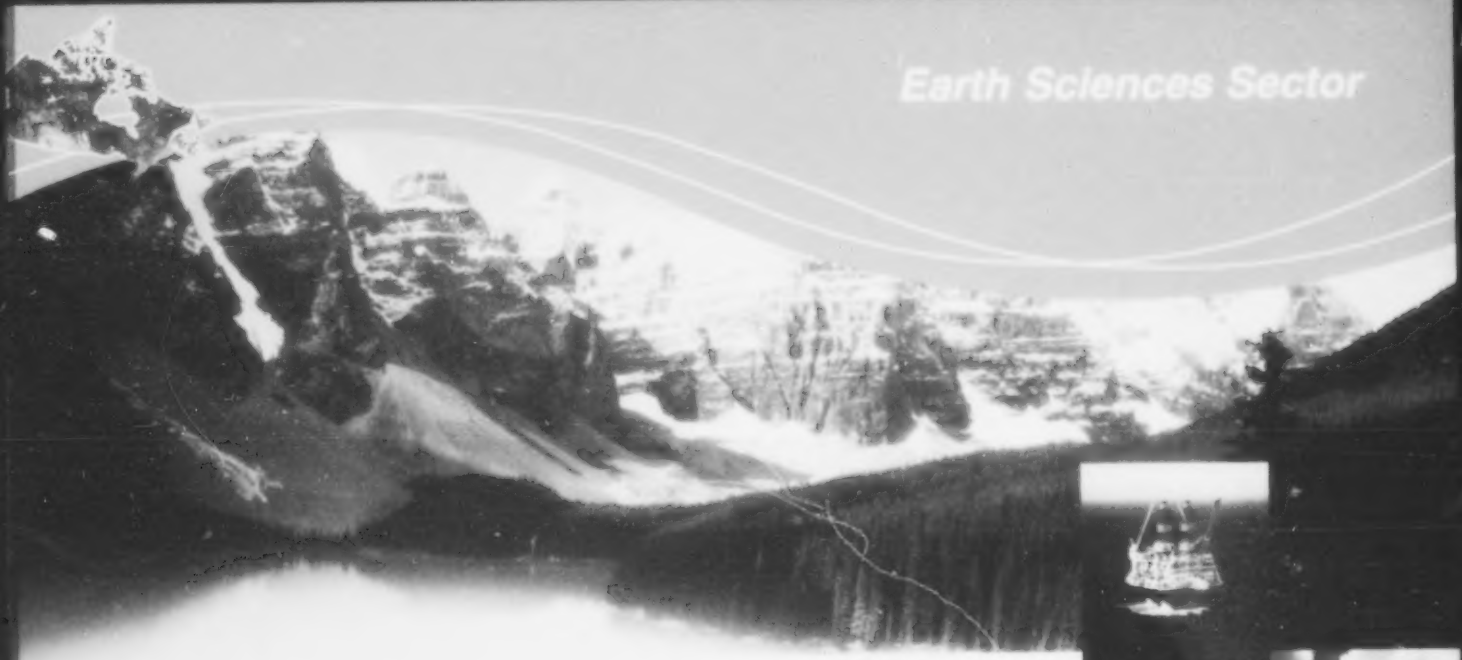
Earth Sciences Sector



Working for Canadians

Annual Review 2003–2004

Natural Resources Canada
Ressources naturelles Canada

Canada

Earth Sciences Sector Annual Review 2002–2004
Working for Canadians

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A Message from the Minister

As Minister of Natural Resources Canada (NRCan), I am pleased to present the 2002–2004 Annual Review of the Earth Sciences Sector (ESS). "Working for Canadians" is a well-chosen title — and a fitting description — for this review, given the Sector's advancements in geoscience and geomatics innovation across the country and its dedication to the sustainable development of Canada's natural resources.

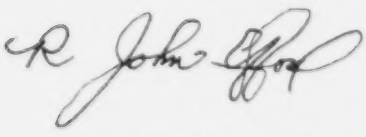
As the Government of Canada's premier source of knowledge on the Canadian landmass, ESS provides expertise and service to Canadians on geoscience and geomatics, conducts innovative research and development, and works to protect our natural environment. It is a dynamic and forward-looking Sector that manages several of Canada's best known institutions, including the Geological Survey of Canada, Geomatics Canada and the Polar Continental Shelf Project, and leads national partnership initiatives such as GeoConnections and the Climate Change Impacts and Adaptations Program.

"As the Government of Canada's premier source of knowledge on the Canadian landmass, ESS provides expertise and service to Canadians on geoscience and geomatics, conducts innovative research and development, and works to protect our natural environment."

Most recently, ESS has continued to address environmental, social and economic issues of importance to Canadians by focusing its science and technology programs on our priorities as a nation. These include a clean environment, strong and safe communities, connecting Canadians, trade and investment, sustainable development, Aboriginal peoples and the development of the North.

I am proud of what ESS has accomplished, and I applaud its work in furthering Canadian knowledge, technology and innovation, both at home and internationally. Together, we will continue to work toward the long-term goals of building a sustainable economy for the 21st century, a healthier environment and strong communities, while affirming Canada's place in the world.

Congratulations on your continued success.



The Honourable John Efford
Minister
Natural Resources Canada

Message from the Assistant Deputy Minister

am pleased to present the Earth Sciences Sector Annual Review entitled "Working for anadians." This Review covers Sector accomplishments for a somewhat longer period than sual, from late 2002 to early 2004, to include the results of the Earth Sciences Sector S&T trategy, which was initiated in fiscal year 2002/2003 to ensure that the Sector's programs ere aligned with, and responded to, government priorities and issues.

he Earth Sciences Sector (ESS) provides Canada with comprehensive geoscience knowledge, nd with quality products and services that describe the Canadian landmass in the form of urveys, maps, remotely sensed data and geographically referenced information. We provide anadians with the knowledge and expertise to understand Canada's landmass, manage our ch natural resources and contribute to the well-being of present and future generations.

Our vision is to be, and be recognized to be, a leader in the development, deployment and ntegration of S&T into policy and decision-making by Natural Resources Canada, the federal nd provincial governments, industry and other stakeholders. To achieve this vision, we have ut the ESS S&T Strategy in place, which is aimed at improving our effectiveness in providing nowledge and service to Canadians. At the same time, ESS continues to strive to be a igh-performance, issues-, outcomes- and outputs-driven organization, known for excellence, ecognized as an employer of choice, aligned with government priorities and linked to other arts of Canada's innovation system.

believe that the Sector has never been better positioned to respond to the priorities and ssues of our government in particular, and Canadians in general. I am proud of the exceptional ffort made by Sector staff over the last two years to implement this Strategy. As a direct result f that work, the Sector's programs and related activities have become essential components f the S&T Canadians need to make informed economic, social and environmental decisions.

applaud the successes of the Earth Sciences Sector as it continues to make a significant and undamental contribution to the quality of life of Canadians through innovations in geoscience nd geomatics. I hope you enjoy this snapshot of our accomplishments from 2002 to 2004.

rwin Itzkovitch, Ph.D.
ssistant Deputy Minister
arth Sciences Sector

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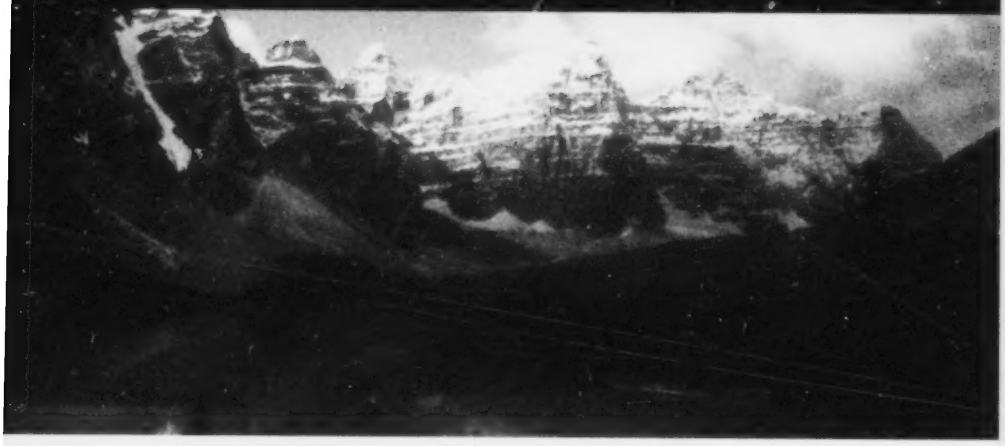
Earth Sciences Sector - An Overview



Moraine Lake in Banff National Park, Alberta.

The Earth Sciences Sector (ESS) is one of five scientific sectors within Natural Resources Canada. It is the Government of Canada's principal Earth sciences agency, providing Canadians with timely and reliable geomatics and geoscience knowledge. ESS supports the environmental, social and economic priorities of the federal government by focusing its science and technology programs on innovative projects that improve the quality of life of Canadians. The Sector also shares its knowledge and expertise in partnerships and cost-recovery projects with clients around the world. The generation and dissemination of information that contributes to the well-being of Canadian citizens is at the forefront of all ESS activities.

The Sector houses the Geological Survey of Canada and Geomatics Canada, two vital organizations that have a strong identity under ESS, as well as three national initiatives, the Polar Continental Shelf Project (PCSP), GeoConnections and the Climate Change Impacts and Adaptation Program.

The Geological Survey of Canada (GSC) consists of the Minerals and Regional Geoscience Branch, and the Sedimentary and Marine Geoscience Branch. The GSC is Canada's premier agency for geoscientific information and research, with world-class expertise focusing on geoscience surveys, sustainable development of Canada's resources, environmental protection and technology innovation. For more information, please see: http://gsc.nrcan.gc.ca/.

Bow Pass in Glacier National Park, British Columbia

ESS is responsible for three national initiatives: GeoConnections, the Climate Change Impacts and Adaptations Program, and the Polar Continental Shelf Project.

Geomatics Canada (GC) consists of the Mapping Services Branch (MSB); the Canada Centre for Remote Sensing (CCRS), which includes the Geodetic Survey Division (GSD); and the Legal Surveys Division (LSD), which includes the International Boundary Commission (IBC). GC is responsible for gathering, analyzing, interpreting, distributing and using geographic information. It is recognized internationally as an organization that provides geospatial information using sophisticated technology. For more information, please see: http://ess.nrcan.gc.ca/geocan/.

ESS is responsible for the following three national initiatives: GeoConnections, a national partnership initiative that is working to build the Canadian Geospatial Data Infrastructure and make Canada's location-based data, applications and services readily accessible on-line to support a wide range of key public priorities; the Climate Change Impacts and Adaptations Program, which supports research to fill critical gaps that limit knowledge of vulnerability, undertakes and supports assessment of impacts and adaptations, enhances collaboration between stakeholders and researchers and facilitates policy development; and the Polar Continental Shelf Project that coordinates logistics support for, and offers expert advice to, Canadian government and university scientists and independent, private-sector and non-Canadian researchers working in isolated areas throughout the Canadian Arctic.

The Sector's Policy, Planning and Coordination Division provides leadership and a central focus for the ESS policy, planning and coordination and communication functions. Through the International Division, strategic direction is provided for the Sector's international activities, and, in doing so, opportunities are created to promote Canadian Earth science industrial products and services globally.

The ESS Office is charged with a key role in transforming the Sector into a more integrated, top-down, issues-driven, high-performance organization. It promotes integration and synergy through the project selection and review processes.

ESS Support Services provides leadership and a central focus for ESS financial, administrative and human resource functions, publishes the scientific output of the GSC and leads the development and management of ESS's information technology infrastructure.

The Chief Scientist provides scientific leadership to ESS and is the Sector's principal interface with external scientific organizations.

105-05916/

Information on the Earth Sciences

The Earth Sciences Information Centre (ESIC) maintains a comprehensive collection of geoscience information, which Canadians can research in person or electronically, and it publishes and distributes the results of the GSC's scientific activities. This is Canada's largest Earth sciences collection of books, journals, maps, atlases and photographs, with world-wide coverage. Clients can access more than two million holdings on the Library's Catalogue, along with the GEOSCAN geoscience data base. ESIC offers a reference service, an Ask-a-Geologist service and document delivery. For more information, please see: http://www.nrcan.gc.ca/ess/esic/. Requests for document delivery should be sent to ESIC.ILL@nrcan.gc.ca. Enquiries can be sent via the Web site or e-mailed to ESIC@nrcan.gc.ca. The Canada Lands Survey Records (CLSR) is the official public repository of all original plans, journals, field notes and other papers connected with surveys made under the authority of the Canada Lands Surveys Act. For more information, please see: http://www.lsd.nrcan.gc.ca/.

The GSC Bookstore carries about 20 000 geoscientific publications that focus on the geological structure and mineral resources of the nation's landmass, including offshore regions. Produced from the research of GSC staff, the publications range from maps to memoirs that date back to the early 20th Century. For more information, please see: http://www.nrcan.gc.ca/gsc/bookstore/. Clients may search the catalogue on-line at: http://www.nrcan.gc.ca/ess/esic/library_catalogue_e.html, or e-mail requests to gsc_bookstore@gsc.nrcan.gc.ca/.

The Canada Map Office is responsible for distributing maps of the National Topographic Series (NTS) and other GC map products to a network of Regional Distribution Centres across Canada. Each year, these centres distribute more than 400 000 topographic maps to end-users through map retailers world-wide. For more information, please see: http://www.maps.nrcan.gc.ca/cmo/, or e-mail topo.maps@nrcan.gc.ca.

The National Air Photo Library has more than six million aerial photographs covering all of Canada, some dating back 70 years. The Library indexes and stores all federal aerial photography for Canada, and also maintains a comprehensive historical archive and public reference centre. For more information, please see: http://airphotos.nrcan.gc.ca/ or e-mail napl@nrcan.gc.ca. For information about places, digital maps, facts, geographical information and learning resources about Canada, please see the Atlas of Canada at: http://atlas.gc.ca/site/index.html.

Program Highlights

A Clean Environment

A clean and healthy environment is essential to a good quality of life.

A clean and healthy environment is essential to a good quality of life. The Earth Sciences Sector is working to ensure that Canadians live in a setting where they can enjoy the sustainable and beneficial use of our country's land and resources, now and in the future. ESS is undertaking ambitious projects that involve studying and mapping major Canadian aquifers, providing information to better assess climate change and its effects, and examining how metals enter the ecosystem with a view to prevention and risk assessment. The Sector also lends its geoscience expertise where new land-use designations are being considered.

Photograph: Robert Ferry

Groundwater

The ESS Groundwater Program is conducting research on the quantity and quality of groundwater resources for the more than 10 million Canadians who rely on it for human, agricultural and/or industrial use. Water-management agencies and well owners need accurate hydrogeological information, maps, publications and models to help in their decision making. Currently under development, a national inventory will provide the information needed to ensure a reliable groundwater supply for Canadian communities. For more information, please see: http://ess.nrcan.gc.ca/pri/env_e.php.

Document Fosters Synergy Among Groundwater Stakeholders

In September 2003, ESS published the Canadian Framework for Collaboration on Groundwater, which proposes a vision and mechanisms to increase the synergy and cooperation on groundwater research in Canada. It also contains a series of national cooperative programs, some of which have already been implemented. A national ad hoc committee on groundwater, with members from federal and provincial agencies, universities and industry, prepared the document, which is being used to develop strategies on groundwater assessments. This collaborative group was formed in 2001 to improve the management and protection of Canada's groundwater resources. For more information, please see: http://www.cgq-qgc.ca/cgsi/default.cfm.

Federal–Provincial Collaboration in the Study and Monitoring of Groundwater
In 2002–2004, ESS initiated hydrogeological characterization studies of four key aquifers in Alberta, British Columbia, New Brunswick and Quebec to identify their characteristics, sustainability and vulnerability. Collaborative monitoring agreements have been drafted with these provinces. In October 2003, representatives from federal and provincial agencies held a workshop to summarize current groundwater monitoring in Canada and to plan a network of monitoring stations. The provinces and territories agreed to share their groundwater data and information, which will be linked to the national groundwater data base.

Climate Change

Research is being conducted on how unpredictable weather patterns affect Canada's landscape and coastal areas, with the results being published in scientific and plain-language reports and new information being incorporated into planning and resource management. ESS research includes an examination of carbon dioxide capture and storage in Canada's geological and biological reservoirs, development of a climate-change mitigation strategy, and a study of paleo-environmental records to determine the impact of past climates. For more information, please see: http://ess.nrcan.gc.ca/pri/env_e.php.

ESS Scientists Part of Successful CryoSat Team
ESS scientists will lead validation work on the Devon Ice Cap in Nunavut as part of the international CryoSat Calibration Validation Retrieval Team, which is being funded by the Natural Environment Research Council of the United Kingdom. When combined with field validation data, satellite measurements will provide the foundation for the assessment of glacier, ice cap and ice-sheet mass balance, their influence on sea-level rise and the state of the marine ice-pack. These measurements will be done at scales and accuracies not achieved by any method to date.

Research Leads to Greater Understanding of Coastal Resources

ESS scientists presented results on variations in sea level, sea ice and the impact of storms in the western Arctic, as well as a model for beach evolution in Nova Scotia, at the 2003 Canadian Coastal Conference held at Queen's University in Kingston, Ontario. They showcased new methods for merging multibeam and other bathymetric technologies with airborne and satellite imagery to characterize coastal topography, erosion and flood hazards. Provincial and territorial governments are using these results for managing coastal resources, assessing natural habitats for species listed under the Species at Risk Act, and as input to the national assessment of climate-change impacts. Follow-up work is underway with federal, provincial and municipal stakeholders on the southeast coast of New Brunswick.

Mitigating Climate Change Effects through Carbon Sequestration

ESS is examining the possibility of decreasing atmospheric concentrations of greenhouse gases through the geological storage of carbon dioxide (CO_2). While not yet proven viable, its potential has attracted the interest of NRCan and five international government sponsors who established the four-year International Energy Agency's CO_2 Monitoring and Storage Project. Carried out in a partially depleted oil reservoir at Weyburn, Saskatchewan, the world's largest sequestration research project is investigating the technical and economic feasibility of CO_2 underground storage. ESS is contributing expertise in seismic monitoring, a powerful tool for verifying the location and integrity of CO_2 stored underground.

Improving Sea-Level Rise Curves for Impact Assessment and Mitigation Planning

An ESS study is examining the dynamics involved in sea-level rise along the east coast of Canada. In this region, sea-level rise is controlled by the additive effects of eustatic (global sea-level changes), isostatic (post-glacial) and tectonic components. ESS scientists, in collaboration with the Bermuda Underwater Exploration Institute, have initiated a sea-level history study to improve the accuracy of sea-level-rise predictions for this century. Since Bermuda is subject only to eustatic sea-level rise, an accurate eustatic sea-level curve can be generated for this region that can also be applied to the Atlantic coast. Three in situ drowned cedar tree stumps from successively shallower water depths have been recovered so far by divers and radiocarbon-dated for incorporation into the new eustatic curve.

Metals in the Environment

Metals enter into the environment through geochemical processes resulting from natural and man-made activities. ESS is investigating how these metals enter the ecosystem under the Metals in the Environment (MITE) Program, thus helping governments make better-informed decisions about prevention and risk assessment. Research is being undertaken in three areas: natural vs. anthropogenic metal toxins, locations where natural variation poses a risk, and the development of a national assessment soil-monitoring system. The MITE Program will be delivered in partnership with four other government departments that have specific responsibilities regarding toxins, as well as with provincial and territorial agencies, and academia. For more information, please see: http://www.nrcan.gc.ca/gsc/mrd/mite/index_e.html.

Environmental Legacy of Historical Gold-Mining Activities

In April 2003, ESS initiated a new multi-disciplinary project to examine the distribution and fate of mercury, arsenic and other contaminants in the environment surrounding abandoned gold-mining operations in Nova Scotia. Researchers took samples at ten mining districts and collected Earth observation data from two sites to assess the impact of mine wastes on local vegetation. The Nova Scotia Department of Natural Resources and three universities (Dalhousie, Ottawa and Queen's) were partners in the project. Preliminary results show that high concentrations of mercury, arsenic and other elements are present at all ten mine sites, and in surface waters and sediments in downstream environments. Ongoing multi-disciplinary studies are providing a better understanding of the specific forms of these contaminants and the potential risks to ecosystems and human health.

Climate-Warming Effects on Mercury Cycling in the Arctic

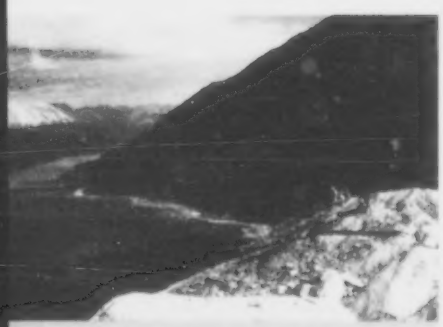
A MITE research project has demonstrated that mercury accumulation in Arctic lake sediments is closely controlled by the productivity of freshwater algae, which absorb mercury from the water. Elevated algal productivity caused by global warming may be increasing the amount of mercury in the algae, which are the foundation for many Arctic food webs. This finding has significant implications for the environment and human health since these food webs may transfer mercury to fish and marine mammals, which are important northern traditional foods. Greater plant growth also means more organic matter in lake sediments that, in turn, promotes the growth of bacteria that convert the mercury to forms more readily absorbed by fish.

Legislated Environmental and Resource Assessments

Under the Legislated Environmental and Resource Assessment (LERA) Program, ESS provides expertise in assessing resources when new land-use designations are being considered. This helps to ensure that all federal government agencies consider the economic and strategic significance of non-renewable mineral and energy resources in their decision making. The Sector's geoscience expertise is also an integral component of the federal environmental assessment review of development projects.

Making Informed Land-Use Decisions

Making informed land-use and development decisions is achieved by the following: ensuring that activities subject to the federal environmental assessment process are designed, constructed, operated, abandoned and reclaimed to minimize adverse environmental impacts; assessing the mineral and hydrocarbon resource potential of Canada Lands under consideration for specialized land-use designation (e.g. parks and marine conservation areas) through the interdepartmental/intergovernmental MERA process; providing advice, data compilations and analysis; and participation in technical and public consultations.



Mineral and Energy Resource Assessments

In 2003, ESS completed a multi-partnered mineral and energy resource assessment for the first phase of a proposed expansion to the Nahanni National Park Reserve. In addition, ESS geoscientists completed the assessment of the mineral-resource potential for two proposed Marine Protected Areas; the Gully (on the Scotian Shelf) and the Beaufort Sea, in partnership with the Department of Fisheries and Oceans (DFO).

ESS's non-renewable resource assessments provide geoscience information that is important when determining the boundaries of the proposed land-use designation and when developing management plans and regulations. This information also helps when assessing the economic implications.

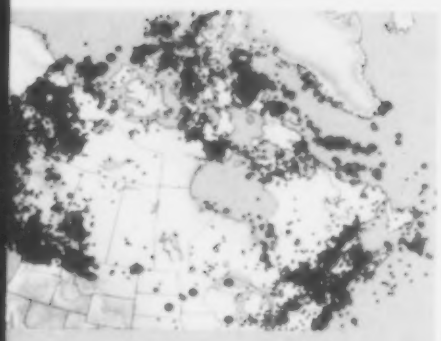
Strong and Safe Communities

Halifax, Nova Scotia

Canadians experience an enviable level of safety and security in their homes, communities and while travelling across the country. The Earth Sciences Sector plays an important and leading role in keeping our communities strong and safe by enhancing our preparedness for natural emergencies, by providing critical aeronautical charts and publications to military and civil authorities and topographical information and maps in case of national emergencies, and by maintaining the land along the border between Canada and the United States.

Natural Hazards and Emergency Response

The Natural Hazards and Emergency Response Program focuses on the five hazards mandated to Natural Resources Canada under the Emergency Preparedness Act (earthquakes, volcanoes, tsunamis, landslides and magnetic storms) and responds to the Federal Nuclear Emergency Plan. This program will develop integrated national hazard assessments, with an emphasis on population centres and critical infrastructures at risk, and will improve access to digital ESS hazard information. Response to earthquakes and geomagnetic hazards is underpinned by national monitoring and observatory networks. For more information, please see: http://ess.nrcan.gc.ca/pri/scom_e.php.



National Seismic Network Monitors "Shakes" in Vancouver Area

The National Seismic Hazard Network has installed about 35 GSC-designed Strong Motion Seismographs in Vancouver and nearby Richmond, B.C. The fledgling network performed flawlessly in its first real test: a magnitude 4.6 earthquake in Washington State on April 25, 2003. Within 60 seconds of the onset, key parameters defining the strongest shaking were received. With a fully operational deployment, Web-based "shake maps" could quickly be made available to emergency organizations and the general public. Shake maps show peak ground accelerations, which indicate the areas of greatest damage. ESS has partnered with local agencies, including the Vancouver and Richmond School Districts who are two of its biggest partners. For more information, please see: http://www.seismo.nrcan.gc.ca/index_e.php.

Detecting and Mapping Airborne Radioactive Material

ESS is enhancing public safety through radiation detection under the Nuclear Emergency Preparedness and Response Project. If radioactive material is scattered by accident or malicious intent, NRCan's Nuclear Emergency team will mobilize an airborne survey within hours to generate real-time information and maps showing the location and type of radioactive material. During multi-agency simulation exercises, ground crews from sister agencies use radioactivity maps from aerial surveys to quickly locate and recover radioactive sources hidden within the search area. In a real emergency, these maps would be critical for early planning and execution of evacuation and containment, through to clean-up, long-term monitoring and forensic investigation.

Accurately Predicting a Major Geomagnetic Storm

NRCan's Space Weather Forecast Centre accurately predicted a major magnetic storm several hours in advance, giving those likely to be affected time to prepare. The storm began on October 29, 2003, and persisted until October 31 (power utilities, companies doing geophysical surveying and those with near-Earth orbiting satellites were most at risk). The second-largest solar flare recorded since 1976 erupted on the Sun on October 28, 2003, generating a massive coronal-mass ejection which streaked towards the Earth at 2000 km/sec. It triggered a magnetic storm that was rated G5, the highest intensity on the storm scale. The specialized Centre, which automatically updates geomagnetic storm warnings hourly on its Web site, is part of the Geomagnetic Hazards Project. For more information, please see: http://www.geolab.nrcan.gc.ca/geomag/home_e.shtml.

Landslide Loss-Reduction Project Decreases Vulnerability

Since 1850, more than 600 Canadians have been killed by landslides, and an estimated $100 to $200 million is spent repairing infrastructure damage each year. The Landslide Loss-Reduction Project has established the protocols and a multi-jurisdictional network for compiling landslide data focused on events of historical significance and those affecting communities or infrastructure corridors. This work is being done in collaboration with the provinces and territories. The landslide data will be used to develop better models of slide behaviour and prediction for local mitigation and land-use decisions. The project is leading in the development of nomenclature and mapping standards so that researchers in different countries can more easily share information. For more information, please see: http://sts.gsc.nrcan.gc.ca/landslides/home_e.asp.

Maintaining the Canada–United States International Boundary

The International Boundary Commission (IBC) oversees maintenance of the boundary under the terms of a 1925 treaty that ensures the enforcement of customs, immigration, national security and other laws. The demarcation of the boundary also allows the federal government to exert the sovereignty of our country. Each year, the Program maintains not less than 150 km of boundary and submits a Joint Annual Report to Canada's Minister of Foreign Affairs Canada (FAC) and the United States Secretary of State. Boundary maintenance includes specific field activities, such as boundary inspection, monument restoration and maintenance, resurveying and vegetation clearing. In light of increased border-security measures, boundary maintenance and clearing by the Canadian section is concentrated in the most populated areas along the Quebec–New York, Vermont, New Hampshire and Maine boundaries, and along the British Columbia–Washington boundary. For more information, please see: http://www.internationalboundarycommission.org/ibcmenup.htm.

Boundary Work Along the Western Border

For many years, the IBC has been working with Canadian landowners along the border at Point Roberts. Letters were sent to occupants in 1993, 1997 and 2000, asking for their cooperation in the removal of encroachments from the International Boundary vista, which consists of a 10-foot swath on each side of the border. An inspection in 2001 revealed that 42 landowners had not removed their encroachments, and they subsequently sought political and media support to prevent the Commission from enforcing the legislation. The Commission proceeded with a four-step plan of action developed in the fall of 2001 and implemented the final phase of the plan in the fall of 2003. The operations were successfully completed and all but one of the landowners has removed their encroachments from the boundary vista.

A-Base Funding Study Addresses a Need

The International Boundary Commissioners for the United States of America and Canada hold formal meetings twice a year. In the fall of 2003, they authorized a consultant-led study to examine funding levels required to address urgent and ongoing boundary maintenance issues until 2008 and to identify resource levels required for subsequent ongoing maintenance. They undertook this approach upon realizing that the mandate of the Commission, as described in the 1925 Treaty of Washington, is not attainable with the current budget envelopes. The study was completed and distributed to FAC in early March 2004. They are currently considering its results and will be working closely with NRCan and the Treasury Board Secretariat on possible options.

Aeronautical Charting

Business, trade and national defence all rely on aerial navigation. ESS produces accurate and relevant aeronautical charts and publications as an essential contribution to the safety and security of Canadian society. A safe and secure airspace allows business to flow, tourism to flourish and Canadians to prosper. For more information, please see: http://aero.nrcan.gc.ca/.

Aeronautical Charting Ensures the Safety of Air Travel for Canadians

The Aeronautical Charting program has delivered updated information to the 2003 Geomagnetism Epoch Model, the Enroute Chart, Canada Air Pilot, Visual Flight Rules, Canada Flight Supplement, Water Aerodrome Supplement, Designated Airspace Handbook, Canadian Aeronautical Charting data base, Air Traffic Controller Charts, and planning and plotting charts products to clients' requirements. Provision of aeronautical charts and publications ensures the safety and efficiency of civil and military air navigation in Canada, as well as the safety of the flying public and every community over which air traffic flies.

Connecting Canadians

Canada is leading the world in building a virtual infrastructure to use geographic or geospatial information for the economic and social benefit of our citizens. The Earth Sciences Sector is establishing important partnerships to develop and exchange innovative on-line geospatial content and services for policy and business decision making. Using the Internet, citizens can now view geographic information about issues that are relevant to them and to the Government of Canada.

Geomatics for Connecting Canadians

Canadians are enjoying better access to ESS geospatial maps, data, services and Web-based applications through the Sector's Geomatics for Connecting Canadians Program. The program delivers products consistent with the policies and standards laid out in the ESS Information Management/Information Technology plan and supports the publication of data, information and on-line services from other ESS programs. Some of the outputs/outcomes are achieved in partnership with the GeoConnections initiative, such as developing common-window access services, reusable technologies and providing on-line national maps. For more information, please see ESS-Led National Initiatives (pp. 39-41).

GeoBase Portal Provides Access to Quality, Unique Geospatial Data

In November 2003, the GeoBase portal was launched to deliver digital geographic data from across the country. Canadians now have Internet access to geospatial data which describes the Canadian landmass, at no cost and with no restrictions for users. It is the first step towards building complete coverage of digital geospatial data for Canada. The portal offers access to six sets of data on the national road network, geographical names, administrative boundaries, geodetic network, elevation data and Landsat-7 ortho-imagery. Critical concerns such as public safety, protection, sanitation and environmental protection use geospatial data in planning, execution and intervention assessments. The portal is hosted and operated by Natural Resources Canada. It was developed with the financial and in-kind resources of federal, provincial and territorial agencies. GeoBase delivers on the framework data commitments of the GeoConnections initiative, which is also a key contributor to the GeoBase effort. For more information, please see: http://www.geobase.ca/.

New Cyber-Initiatives for Connecting Canadians with their Geography

The Archive Maps of Canada, launched during Canada Day celebrations, is a compilation of 943 maps that have been digitally reproduced from previous print collections of the Atlas of Canada dating back to 1906. Canadians can now view almost 100 years of Canadian geography on-line. New configurable Web mapping tools have been developed with the support of GeoConnections and are being reused across many ESS applications. The flexibility and capabilities of these tools means they can be quickly integrated into Web sites, thus saving further development costs. A major redesign of the Atlas of Canada's Web site was launched in October 2002 in conjunction with its name change from the National Atlas of Canada. The new Web site makes the Atlas information more easily accessible to Canadians, contributing to the efforts to build the Canadian Geospatial Data Infrastructure (CGDI). The CGDI is making Canada's geospatial data bases, tools and services readily accessible on-line. For more information on the Atlas, please see: http://atlas.gc.ca/site/english/index.html.

The Bank of Canada invited the Atlas of Canada to be involved in creating the new $100 bank note.

A New Bank Note Celebrates Innovation and Exploration through Mapping

The Bank of Canada invited the Atlas of Canada to be involved in creating the new $100 bank note, which celebrates "innovation and exploration" through mapping. Geographers and cartographers from the Atlas melded historical and satellite images to illustrate Canada's history of cartography and cutting-edge mapping technology. An historical map created by Champlain in 1632 and an image of a birch-bark canoe represent cartography's beginning, while images of Canada's Earth observation satellite, RADARSAT, and an NRCan ground station illustrate the new technologies of innovation and exploration. The background map of Canada is surrounded by images of mapping methods. The note was unveiled in January 2004 and issued in March 2004.

Sustainable Communities Initiative: Empowering Canadian Communities

The Sustainable Communities Initiative (SCI) of GeoConnections is building and strengthening the capacity of Canada's rural, remote and Aboriginal communities to use geospatial information and GIS tools for their social and economic development, which enables them to participate meaningfully in decisions about sustainable development and land use. The program concentrates on natural resources and the environment, and uses economic and social information on the community, region and nation. SCI funds 10 to 12 communities per province or territory and has committed to completing 109 projects for the spring of 2005, exceeding its mandate of 100 projects. For more information, please see: http://www.sci.gc.ca/text/b1.html.

Many communities have benefited from SCI projects. For example, six northern Alberta Métis settlements received assistance in 2003–2004 to build resource-management capacities in their communities. By applying GIS and GPS, one community devised a forest-mapping sequence that specified which blocks of trees to cut from year to year; others mapped oil and gas pipelines, roadways and settlement buildings, and developed emergency-preparation plans. Under an SCI Sanitary Shellfish Project that began in 2001 and continues to this day, Miramichi River Environmental Assessment Committee (MREAC) began using GIS to target water quality for shellfish harvesting, by identifying and assisting in the remediation of pollution sources in a 34 km^2 area of the Miramichi River. This resulted in an area of up to 15 km^2 opening up to shellfish harvesting, which will benefit several communities along the Miramichi Inner Bay, the City of Miramichi and First Nations communities.

Trade and Investment/Creating and Sharing Opportunities Globally

Canada's Earth sciences industry is a major contributor to the Canadian economy and a key player in the global economy, demonstrating its comparative advantage by competitively exporting products and services. The International Division and the Global Opportunities Program of the Earth Sciences Sector provide leadership by helping set strategic direction for ESS's international activities, many of which are undertaken with the private sector.

Trade and Investment

The Sector's International Division provides leadership and support for ESS by spearheading international activities; coordinating efforts and monitoring issues related to trade and investment; enhancing the use of Canadian Earth sciences knowledge and technology in supporting sustainable development of developing countries; and providing guidance to the Sector in business practices. The Division also works with all ESS programs to ensure that their international activities fully support the government's international and domestic priorities.

ESS Undertakes a Technical Mission to China

Dr. Irwin Itzkovitch, the Sector's Assistant Deputy Minister (ADM) of ESS, led a 20-day technical mission to China in October 2002 at the invitation of Ms. Shou Jiahua, Vice Minister of the Ministry of Land and Resources (MLR) of the People's Republic of China. The objective of this technical mission was to strengthen relations between ESS, MLR and other central and regional Chinese government organizations in the Earth sciences. The mission focused on four existing Memoranda of Understanding (MOUs) in geosciences; remote sensing and Geographic Information Systems (GIS); surveying and mapping; and space science, technology and applications.

The International Division and the Global Opportunities Program of the Earth Sciences Sector provide leadership by helping set strategic direction for ESS's international activities, many of which are undertaken with the private sector.

On October 14, 2002, Dr. Irwin Itzkovitch, Assistant Deputy Minister (ESS), and Mr. Lü Yuchen, Deputy Director General, China Seismological Bureau, signed an MOU on cooperation in earthquake studies.

Photograph: Richard Lovett

ESS Leads a Natural Resources Mission to India

In November 2002, the Minister of Natural Resources Canada led a delegation to India, the largest Canadian mission to date devoted to natural resources and related industries. During this mission, two MOUs regarding Earth sciences were signed for cooperation in geomatics and spatial information. One MOU was between the Ministry of Science and Technology of the Government of India and NRCan, and the other was in geospatial information technology with the State of Andhra Pradesh. This mission laid the groundwork for two other cooperation agreements to enhance scientific and technical collaboration in Earth sciences, as well as trade and investment.

In November 2003, Dr. Itzkovitch led a follow-up business development mission to India to advance specific business opportunities and cooperation under various MOUs. Canadian geomatics companies with a strong expertise in spatial data infrastructure accompanied the ADM on this trip.

Geomatics MOU Signed during ESS Mission to Thailand

In November 2003, during a visit to Thailand, an MOU was signed with the Geo-Informatics and Space Technology Agency (GISTDA) for cooperation in geomatics and spatial information. As a first deliverable under this new MOU, a workshop on spatial data infrastructure (SDI) was conducted jointly by GISTDA and ESS in cooperation with the Canadian GeoProject Centre. The principal objective of the workshop was to introduce Canada's SDI (i.e. the CGDI) and GeoConnections initiative while understanding the status of Thailand's SDI.

ESS Signs MOU with Geological Survey of Japan

On January 15, 2004, Dr. Itzkovitch and Dr. Takemi Ishihara, Director of the International Geoscience Office of the Advanced Institute of Science and Technology of Japan, signed an MOU between the Geological Survey agencies of Japan and Canada for collaboration in the Earth sciences. Collaboration with Japan continues to be mutually beneficial as it provides ESS personnel with access to resources and state-of-the-art facilities. Dr. Ishihara's one-day visit, co-hosted by the International Division and the GSC, included presentations related to earthquakes, landslides, geohazards, gas hydrates and a visit to the Sensitive High Resolution Ion Microprobe facility. These areas of interest may be pursued as project annexes under the auspices of the MOU.

Global Opportunities

The Global Opportunities Program manages ESS international projects that assist industry in reaching new markets while addressing developing countries' priority issues. Working closely with the Sector's International Division, this program coordinates ESS participation in externally funded international development projects where Earth sciences can make a significant contribution to social, economic and/or sustainable development. For more information, please see: http://ess.nrcan.gc.ca/pri/int_e.php.

The Multinational Andean Project: Geoscience for Andean Communities

Since 2002, this six-year ESS-managed project has been helping to improve the lives of Andean people by reducing the impact of natural hazards such as earthquakes, landslides and volcanoes. Known as MAP:GAC, this project is updating and integrating geoscience and geospatial information on natural hazards for land-use planning and to mitigate the effects of natural hazards. It is funded by the seven participating nations (Argentina, Bolivia, Colombia, Chile, Ecuador, Peru and Venezuela) and the Canadian International Development Agency (CIDA). As well, the geological surveys of Ecuador and Peru are collaborating on a bi-national drainage-basin project in the Catamayo–Chira basin area, which was formerly under conflict.

ESS Expertise Helps Tunisia Develop a Geomatics Program

ESS is contributing to sustainable development in Tunisia by helping to establish a national infrastructure for digital geographical data. Since 2002, representatives of ten Tunisian government departments have been working with ESS and DMR Conseil Inc. to develop the GÉONAT framework. After conducting a complete inventory of Tunisia's current geomatics capabilities, including technical, legislative and institutional components, a strategic plan for implementing the national framework will be developed. In 2002–2003 Université Laval delivered geomatics courses to 26 managers from various Tunisian government departments that use geospatial information. CIDA provides $4.3 million in funding for this project.

ESS Project Improves Brazilian Groundwater Resources

The Northeastern Brazil Groundwater Project (PROASNE) launched in April 2000, and continuing until December 2004, will be easing the hardship of Brazilians. Through this Canada–Brazil project, ESS transfers and adapts Canadian technologies that improve the development and management of groundwater resources in northeastern Brazil. As a participant of PROASNE, Waterloo Hydrogeologic Inc. has carried out several projects to augment sustainable access to safe drinking water, such as updating the National Groundwater Information System (a collection of groundwater data-management tools accessible through the Internet). Based on this technology's success in Brazil, Waterloo Hydrogeologic is developing similar systems for the Ontario Ministry of the Environment and for the Government of Lesotho.

Sustainable Development of Natural Resources

Sustainable development of Canada's immense natural resources requires careful decision making to efficiently and responsibly use our natural, human and economic resources. ESS is contributing to Canada's progress on sustainable development by collecting, processing and making accessible its geological and geomatics knowledge.

Geoscience for Oceans Management

This program contributes to the geoscience knowledge that is required to inform decision making in Canada's offshore lands so that land-use, including offshore structures and resource-development decisions, balance social, economic and environmental considerations. Underpinning this program is a systematic approach to sea-floor mapping to deliver geoscience knowledge for integrated ocean management. The legislative and strategic framework for this program is found in the *Canada Oceans Act* and Canada's Oceans Strategy. For more information, please see: http://www.gom.nrcan.gc.ca/.

Deep-Water Geohazards off Newfoundland

Deep-water offshore Newfoundland is one of the most active hydrocarbon exploration frontier areas in Canada. The area is harsh, with risk of landsliding on the continental slope and much of the sea floor being swept by strong currents. In the summer of 2003, scientists aboard the *CCGS Hudson* obtained new information in and around Orphan basin on the engineering properties of sea-floor sediment, the distribution of deep-water currents and the past flux of icebergs (important for assessing iceberg-scour risk to pipelines). ESS advises the Canada–Newfoundland Offshore Petroleum Board and industry groups on sea-floor hazards and engineering properties.

Geoscience for Ocean Management of Queen Charlotte Basin

ESS, in partnership with the Department of Fisheries and Oceans (DFO), used multibeam swath bathymetry to survey key areas of potential conflict in the Queen Charlotte Basin, a World Heritage site, in 2003. These areas included four globally unique sponge reefs, an area with a significant groundfish industry and hydrocarbon potential, and an area in the proposed boundaries of a national marine park. Regional multibeam mapping in Queen Charlotte Basin will continue for the next three years. Geoscience information is essential to informed decision making, especially if the moratorium on hydrocarbon exploration were to be lifted and if marine wind-farms were to be developed. The B.C. provincial government set up a team to assess offshore oil and gas opportunities, and the Queen Charlotte Project has provided much of the background geoscience information for outreach.

Surficial Geological Constraints on Scotian Shelf Pipelines

Expert advice from ESS is helping to identify which routes pipelines, such as the proposed "Blue Atlantic" Transmission System (ElPaso Eastern Pipelines Group), will take to reach markets along the eastern Atlantic seaboard. ESS has identified and characterized the geological conditions through difficult pipeline terrain on the inner shelf of the South Shore of Nova Scotia. In 1993, findings led directly to the route of the proposed "Blue Atlantic" corridor being changed. Within the broader context of integrated management on the Scotian Shelf, ESS has developed the geological framework and constraints to define proposed "utilities corridors" to route these seabed installations. DFO is now incorporating these recommendations in the Eastern Scotian Shelf Integrated Management Plan. The Scotian shelf is a shallow, high-energy environment, presenting unique challenges to pipeline engineering. ESS research on seabed dune dynamics and sand mobility on Sable Island Bank addresses the potential pipeline span on the existing Sable Offshore pipeline across large bedforms in shallow water on the banks.

Mapping the Bras d'Or Lakes, Nova Scotia

The Bras d'Or Lakes in Nova Scotia constitute Canada's largest inland sea and were true lakes until 5000 or 6000 years ago, when the ocean flooded in. ESS has carried out multi-year research of these lakes with its principal stakeholders, the First Nations of Cape Breton, in cooperation with DFO. Since April 1, 2002, ESS scientists and technicians have collected large amounts of new multibeam bathymetric data and ground-truthing information. They are incorporating data into a GIS system, including information on coastal types that will be used to assess their sensitivity to future sea-level rise. This will complement ESS estimates of the rates of sea-level rise in the area achieved through radiocarbon dating. In addition, ESS surveys have shown that sand and mud are being pumped into the lakes from the ocean, a process similar to that in estuaries around the world.

Assessing the Offshore Disposal of Dredged Materials

Canada's ports and harbours are routinely dredged to maintain open shipping lanes and allow the passage of deep-draft vessels, and these dredged materials are often placed in offshore disposal sites. For the last two years, ESS has been working with Environment Canada to understand the long-term fate and impact of dredged materials on the marine environment, and to develop acceptable disposal practices that respect the unique marine environment of each site. ESS is monitoring several sites on the Atlantic and Pacific coasts. Geophysical and multibeam bathymetry surveys characterize sea-floor sediments at the dredging and disposal sites to determine how the sea floor is affected. Results from these studies are being used to monitor the effects of disposal at Point Grey, B.C., and in Saint John Harbour, N. B., and to evaluate alternative dumping practices and locations. New insight into the management of sites is already helping stakeholders develop new policy and enabling the incorporation of offshore disposal of dredged materials in regional development and management plans.

Gas Hydrates

The Gas Hydrates — Fuel of the Future? Program contributes to the development of this unconventional energy source. Gas hydrates could hold 1000 years of an environmentally friendly fuel supply, compared to about 10 years of natural gas reserves and 100 years of conventional gas resources. ESS coordinates the science activities of the program, which identifies the gaps in scientific and technological knowledge required for the sustainable development of this resource. Large gas-hydrate deposits are located mainly in the high Arctic and in offshore areas at water depths greater than 800 metres. For more information, please see: http://ess.nrcan.gc.ca/pri/sdev e.php.

Mallik Well Featured at Japanese Gas Hydrate Research Symposium

The Mallik 2002 Research Well Consortium Partners and the Technical Research Centre of the Japan National Oil Corporation sponsored the "From Mallik to the Future" International Gas Hydrate Research Symposium in Makuhari, Japan, in December 2003. NRCan is a lead member of the consortium. The conference reported on the scientific and engineering breakthroughs of the Mallik 2002 Gas Hydrate Research Well Consortium drilled in the Mackenzie Delta, Northwest Territories. The meeting emphasized the need to develop international collaborations of broadly based scientific and engineering research regarding all aspects of gas hydrates if this potential resource is to be properly evaluated. For more information, please see: http://sts.gsc.nrcan.gc.ca/gashydrate/mallik2002/home.asp.

ESS Co-Hosts First Canadian Workshop on Natural Gas Hydrates

The ESS Gas Hydrates — Fuel of the Future? Program and the University of Victoria's Centre for Earth and Ocean Research co-hosted the first Canadian Workshop on Natural Gas Hydrates at GSC Pacific in March 2004. The meeting heard presentations on gas hydrate research in Canada as it applies to fuel research, climate change, environmental science, geotechnical hazards and industrial processes. Special sessions provided the opportunity to develop a list of research needs and gaps, to identify sources of funding and collaboration, and to get a petroleum industry perspective on gas hydrate research. Three university-led working groups were formed to plan engineering, geoscience and climate science collaborative research opportunities, with the goal of establishing a Natural Sciences and Engineering Research Council of Canada (NSERC) gas hydrate research network in Canadian universities that will complement and cooperate with the established programs in government agencies. A meeting will be held in Calgary to report on the progress toward a university-led research network initiative and to increase the industrial participation in gas hydrate research.

The Targeted Geoscience Initiative

The Targeted Geoscience Initiative (TGI) stimulates sustainable economic development by increasing private-sector exploration for energy and mineral resources in high-potential regions. It advances the Government of Canada's commitment to the sustainable development of our natural resources — contributing to their economic importance and to a strong society and communities through knowledge, innovation, technology and international leadership. Over the past three years, the TGI has produced new geological and geophysical maps and data for previously under-explored areas with a high potential for mineral deposits. TGI projects are undertaken in partnership with provincial and territorial geoscience agencies, industry and academia.

TGI Funding Extension Includes Energy and Minerals Geoscience

The success of the TGI, which was initially funded for three years in 2000, led to a two-year extension to support energy and minerals-related geoscience. New projects have begun to examine the hydrocarbon potential across Canada. The release of new geoscientific knowledge — geological compilations, analyses of petroleum systems and mineral deposit studies — from this initiative is expected to significantly increase the effectiveness of private-sector energy and mineral exploration, and the consequent development of northern communities. Some examples of successes from TGI projects are listed below.

High-Grade Gold Discovered in Committee Bay, Nunavut

The Committee Bay area in Nunavut had experienced little exploration until the TGI-funded Committee Bay project, jointly delivered with the Canada–Nunavut Geoscience Office, produced framework geology and drift-prospecting maps that greatly augmented and facilitated private-sector investment in mineral exploration in the area. Based on these results, successful exploration programs by industry in 2002 and 2003 led to the discovery of high-grade gold occurrences, and to exploration investment in this area planned over the next three years.

British Columbia Attracts Mineral Activity

In British Columbia, new and integrated aeromagnetic surveys, bedrock mapping, structural and stratigraphic studies, and geochronology and geochemistry have been carried out under the TGI in collaboration with the B.C. Ministry of Energy and Mines. In the Atlin area, a high-grade copper occurrence, called the Joss'alun showing, was discovered during regional mapping in 2002. This contributed to Atlin being one of the most actively explored areas in British Columbia, according to the province's Mineral Tenure data base, with more than 10 500 hectares of new mineral claims and 2825 hectares of new placer claims being staked since the TGI-funded project began. Further exploration by industry in 2003 located two new copper deposits in the adjacent area, and exploration is ongoing.

Red Indian Line Project Yields Vital Geoscience Information

The Red Indian Line project in Central Newfoundland, which began in 2000, has made a significant contribution to the scientific understanding of the area and provides a strong foundation for future geological investigations. Following the discovery of significant new Carlin-style gold deposits (e.g. the Golden Promise near Badger), the project was expanded to provide the exploration community with updated regional 1:50 000 scale geological maps and other geoscience information to areas beyond the project's original mandate. This will provide a foundation for focussed future exploration for these types of deposits.

Photograph: Art Hayes

Collaborative Energy Project in Eastern Canada to Guide Offshore Exploration

In 2002–2003, a new collaborative energy project in Eastern Canada was initiated under phase II of the TGI to generate new hydrocarbon systems data and a better understanding of the areas where natural gas and gas hydrates occur. The resulting information will guide offshore exploration and minimize the risk of upcoming exploration drilling. This TGI project is being undertaken in collaboration with the geological surveys of New Brunswick, Newfoundland and Labrador, Nova Scotia and Quebec, and six Canadian universities. Provincial surveys and the private sector contribute financially to the project and new agreements formalize their contribution, including a near-shore seismic acquisition program in the St. Lawrence Estuary and high-resolution aeromagnetic and gravimetric surveys.

Geomatics for the Sustainable Development of Natural Resources

The Geomatics for the Sustainable Development of Natural Resources (GSDNR) Program promotes awareness of and access to ESS's high-quality geospatial information and products to support responsible decision-making for the sustainable development of Canada's natural resources. GSDNR and its associated portfolio of projects provide basic geospatial information layers (geographic names, national thematic frameworks, elevation data, hydrography, transportation networks and satellite ortho-rectified imagery) according to national data standards achieved through partnerships and a common technological environment with various data producers. For more information, please see: http://gsdnr.nrcan.gc.ca/.

The Canada-wide Differential GPS Service Launched

The Canada-wide Differential GPS Service (CDGPS) officially started broadcasting in mid-October of 2003, providing access in real time to NRCan's GPS corrections via the North American mobile satellite station (MSAT). The CDGPS provides those who create and integrate geospatial information with a more accurate and efficient geo-referencing capability consistent with the national standard for coordinates, as well as with geospatial systems such as GeoBase. Funded through an agreement signed by all of the provinces, Nunavut and GeoConnections, the CDGPS is a nation-wide service with application to forestry, precision farming, resource management, mapping and geographical information systems, and navigation. ESS's Canadian Geodetic Service provides the GPS Corrections signal (GPS•C) that serves as the basis for this initiative. While the service is accessible free of charge, five Canadian companies are commercial distributors of the required CDGPS receivers. For more information, please see: http://www.cdgps.com/.

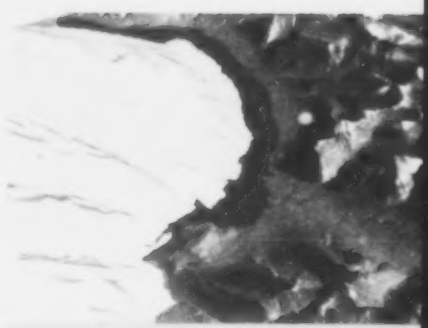
Geomatics Advancing with Space-based Positioning Technology

The transition to space-based positioning technology is progressing rapidly, enhancing geo-referencing capabilities at all levels. The geomatics community is responding to the increased accessibility of GPS-related data products created by the Canadian Geodetic Service (CGS), such as GPS satellite orbit and clock corrections. Statistics indicate a doubling of on-line data downloaded by users in 2003–2004 compared to the previous year, and more than a six-fold increase from 2001–2002. While the latter dramatic increase may be due, in part, to the elimination of information access charges, the continued expansion in access by geospatial

professions indicates that the targeted outcomes of the CGS are being advanced. These outcomes include readiness for society's increasing dependence and use of positioning as the next utility, and enhanced efficiency and effectiveness of space-based positioning technology applied to surveying, mapping, navigation and land-resources management sectors. For more information, please see: http://ess.nrcan.gc.ca/pri/serv_e.php.

National Scale Frameworks Drainage Areas Dataset — A National Standard

Several government agencies have recently adopted the 1:1M National Scale Frameworks Hydrology — Drainage Areas Dataset as a reporting base. The dataset was developed by the Geomatics for the Sustainable Development of Natural Resources (GSDNR) Program, through the Atlas of Canada. Developed in partnership with Statistics Canada, Environment Canada and GeoConnections over a period of two years in 2001–2003, the framework provides data for drainage basins in spatial units ideally suited for environmental analysis. Statistics Canada, and Agriculture and Agri-Food Canada are evaluating the dataset as a geographic standard to identify sustainable development indicators for reporting on the interaction of agriculture and the environment for soil, air, water quality, biodiversity and eco-efficiency.



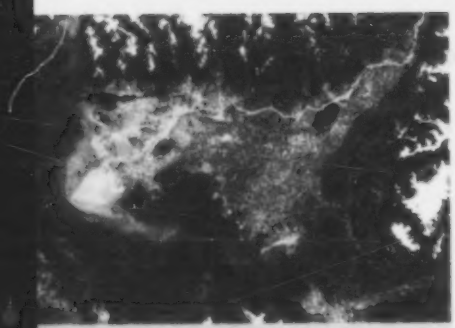
National Hydrographic Network Supports Environmental Monitoring and Reporting

Wetlands have been identified by the National Round Table on the Environment and the Economy as one of the key indicators to track the sustainable development of Canada's natural and human assets. In 2003–2004, GSDNR began constructing and delivering the National Hydrographic Network (NHN) as a contribution to the Canadian Information System for the Environment (CISE), an Environment Canada (EC) project. CISE has a key role to play in expanding the collection, management, integration, assessment and communication of environmental data and knowledge at the national level.

In 2003–2004, in collaboration with EC, GSDNR conducted a pilot study using the NHN in the Maritimes. A partnership of several departments from the federal and Nova Scotian governments is producing a hydrographic model for the Pockwock Lake watershed, a drainage basin that supplies water to the Halifax Regional Municipality. The Nova Scotia Geomatics Centre will supply data, and the model will be used to test the NHN through CISE as input for the development of a comprehensive watershed-management tool.

Earth Observation Data Supports Environmental Monitoring and Reporting
GSDNR provides precise, geo-referenced Landsat 7 satellite imagery coverage of Canada. This unique source of digital data is being used to monitor land cover and to support a variety of applications, such as Environment Canada's National Carbon Stocks reporting system and the Canadian Forestry Service's next-generation forestry mapping and monitoring system.

Several provincial departments, including the Ontario Ministry of Natural Resources (OMNR), use ortho-rectified images for reporting on the environment; in fact, the OMNR is using the images to produce a new provincial land cover data base. OMNR provides data base access for internal government uses, such as wildlife and conservation, forestry, ecological mapping and transportation planning. The Quebec Ministère des Ressources naturelles, de la Faune et des Parcs, uses Landsat 7 ortho-rectified images to provide up-to-date information on fire mapping and regeneration inventories, classifying ecological districts, identifying landslide-prone areas and conducting municipal planning.



Consolidating Canada's Geoscience Knowledge

The Consolidating Canada's Geoscience Knowledge (CCGK) Program has made significant progress towards enhancing the nature and scope of ESS partnerships with provinces, territories, industry and academia, and in providing for more efficient, effective and comprehensive access to geoscience information and knowledge. Canada's global competitiveness for attracting oil, gas and mineral exploration and development investments, and its ability to make sound decisions concerning sustainable development, is partly predicated on realizing these goals. For more information, please see: http://ess.nrcan.gc.ca/pri/sdev_e.php.

Cooperative Geological Mapping Strategies Supports Resource Geoscience Knowledge
The Cooperative Geological Mapping Strategies (CGMS) is a ten-year, federal–provincial–territorial initiative to ensure that Canada's public geoscience knowledge base continues to be a significant competitive advantage in attracting investment in mineral and energy resource exploration in Canada. Approved by Canada's federal, provincial and territorial Mines Ministers in 2000, the CCGK program is working towards a joint implementation plan for this initiative. Another program goal is to have ESS, provincial and territorial digital knowledge sets and catalogues fully interconnected and adopted as the definitive source of resource geoscience knowledge for Canada.

Mineral and Energy Geoscience Syntheses

Two major synthesis and compilation projects are developing a comprehensive assessment of Canada's resource (minerals and energy) geoscience knowledge. This will provide the essential context to efforts underway to prioritize continuing resource geoscience studies in Canada and will serve to provide industry and governments with an instrument to assess exploration and development risk.

Appalachian National Mapping Program Projects Support Resource Exploration

Since 1993, ESS has conducted two multi-partner and multi-disciplinary projects in the Appalachians, under the National Mapping Program (NATMAP). These projects have generated new geoscience models and interpretations that have been critical to the high level of fossil-fuel resource exploration in eastern Canada. Exploration efforts currently focus on the under-explored onshore basins in Gaspé, southern New Brunswick, central Nova Scotia and western Newfoundland, where most of the prospective lands are under exploration licences. The research results served as building blocks for the new federal–provincial–academia–industry Appalachian energy Targeted Geoscience Initiative project in eastern Canada.

Earth Sciences Sector's Geoscience Data Repository

The Earth Sciences Sector is committed to making its vast geoscience data, information and knowledge assets easily discoverable, evaluated, visualized and available through the Web. The Geoscience Data Repository is an initiative to interconnect a myriad of resource geoscience data sets across the country to provide on-line availability. The program is continuing its efforts with the provinces and territories to provide similar functionalities through the Canadian Geoscience Knowledge Network.

Canadian Geoscience Knowledge Network

The Canadian Geoscience Knowledge Network (CGKN) initiative is helping to create integrated, comprehensive on-line data bases of geological, geophysical and geochemical information that can be used to assess the potential for oil, gas and valuable mineral deposits and future resources. The initiative has developed a single Internet portal for the discovery and evaluation of Canadian geoscience data and publications. Under the TGI, the federal, provincial and territorial geoscience agencies in Canada have created comprehensive catalogues describing geoscience data, maps and publications in a consistent and standardized format. Resource industries, academia and government agencies are able to gain access to this information via an Internet search engine by logging on to http://www.cgkn.net/.

Sustainable Development through Knowledge Integration

Initiated in September 2003, the Sustainable Development through Knowledge Integration (SDKI) Program is collaborating with several Canadian partners to implement innovative approaches to decision making that use geospatial and geoscience information and knowledge. This program supports NRCan's mandate to promote the sustainable development and responsible use of Canada's natural resources, and to collect and disseminate information on sustainable resource development. ESS is committed to helping Canadians use sound scientific knowledge when making decisions on natural resources. This includes innovative technologies and geoscience assets, including extensive and unique archives of geospatial and geologic data. The challenge is to integrate the many sources of information and technology into a format that provides unrestricted access to reliable and high-quality data. For more information, please see: http://ess.nrcan.gc.ca/pri/sdev_e.php.

Sustaining Urban Growth from a Transportation Perspective

An SDKI project is helping major Canadian cities deal with urban sprawl by using satellite data to track change so the sustainability of urban growth from a transportation perspective can be gauged. Urban sprawl can lead to the loss of valuable agriculture and eco-sensitive lands (e.g. wetlands and forests), along with higher energy consumption and greenhouse-gas emissions from an increased use of private vehicles. Land-use and urban-form information derived from the past 30 years of Landsat satellite data is being used to track changes over time for these cities. The Landsat change maps are augmented with additional information from the National Road Network, population census data and other data sources. From these integrated products, quantifiable indicators such as land-use mix, transportation congestion and transportation land use are being produced to help determine a course for the future.

Rehabilitating the KamKotia Mine Site

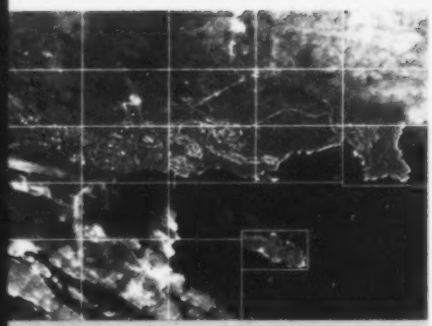
In 2004, the SDKI project "Sustainable Management and Rehabilitation of Mine Sites for Decision Support" started a study using new remote-sensing techniques for mine monitoring and reclamation. This study supports reclamation at the KamKotia mine in northern Ontario, a project of the Ontario Ministry of Mines and Northern Development (OMND) Abandoned Mine Rehabilitation Program. From 1942 to 1972, approximately 2.7 million tonnes of tailings were discharged in the area around the KamKotia mine. In 2001, OMND began a multi-year project to rehabilitate this site. A baseline map of the site will serve as a basis of comparison with maps produced by SDKI in subsequent years. It will also be used to evaluate the success of reclamation efforts and help to ensure that costly rehabilitation actions are effectively minimizing environmental damage.

Aboriginal Peoples

The Earth Sciences Sector is contributing to better knowledge and understanding of Northern communities and the Aboriginal peoples who live in them by providing new maps, procedures for changing place names, training and technology transfer, and using geoscience to discover and analyze mineral wealth. Projects under GeoConnections' Sustainable Communities Initiative are providing rural, Aboriginal and Northern communities with the tools and training they need to use modern mapping technologies to make informed decisions for sustainable development. Reliable and consistent geospatial information and well-defined property rights are an important part of development and investment in the North and the people who live there. For more information, please see: http://ess.nrcan.gc.ca/pri/ap_e.php.

Geomatics for Aboriginal Property Rights Infrastructure

The Geomatics for Aboriginal Property Rights Infrastructure (GAPRI) Program provides fundamental governance support to the First Nations' devolution process and contributes to the economic and social success of Aboriginal people by delivering and promoting a robust, reliable and flexible property rights infrastructure. By ensuring that the extents of rights in land are well defined, and that related land information is managed in a secure and accessible manner, this program supports investment in communities and sustainable development. The infrastructure supports other land-management activities, such as land-use planning and environmental protection. For information on The Spatial and Historical Evolution of Iqaluit, please see: http://maps.nrcan.gc.ca/iqaluit/.



Orthomosaic showing the development of Iqaluit in 2000.

Banff National Park from Mount Couley, British Columbia

ESS and INAC to Integrate Their Information on First Nations Lands

ESS and Indian and Northern Affairs Canada (INAC) are working on a project to integrate work processes and data bases that contain information about First Nations lands. INAC maintains the Indian Lands Registry (ILR), and the Canada Lands Survey System (CLSS) maintains cadastral parcel maps. These maps are used as indexes to access legal survey documentation recorded in the CLSR. INAC and NRCan also maintain segments of essential land information. Currently, there is no one-stop-shopping location for information on First Nations lands. Access to reliable land information is essential to their ability to manage, plan and make timely decisions about their holdings. Therefore, it is vital to accurately determine the current ownership or tenure status, together with the physical extents of existing interests in the land. When the integration is complete, the CLSS will become more efficient in matters related to surveying, storage of and access to the survey plans.

The Manual of Instructions for the Survey of Canada Lands Goes On-Line

The fall of 2003 marked another "first" for ESS's Legal Surveys Division (LSD) as they went on-line with the Manual of Instructions for the Survey of Canada Lands. The electronic version is both dynamic and flexible, permitting various parts to be amended in real time. The Web site also contains publications from 1871 to 2003 and their amendments, giving users access to all historical general instructions in effect for any given period of time. The Manual of Instructions ensures the lawful, clear and unambiguous delineation, demarcation, depiction and description of land parcels and their boundaries. The LSD's Information Management/Technology Unit is developing the site into a flexible tool that accommodates client needs and ensures maximum harmonization with provincial survey practices.

First Nations Land Management Initiative

The First Nations Land Management Initiative (FNLMI) is a key component of federal support for First Nations community self-government. Certain land-management responsibilities currently under the *Indian Act* will soon be transferred from Canada to First Nations communities. An accurate determination of the extents of the land base is required before this transfer can take place. In May 2003, an Interdepartmental Letter of Agreement was signed between INAC, the First Nations Lands Management Act and NRCan. Through its regional Client Liaison Unit Offices, ESS delivered legal surveys, mapping and land descriptions required to transfer the land administration to the First Nations under the FNLMI.

New Framework Accord between INAC and NRCan

A new Framework Accord, signed in December 2003, reflects the continued commitment by the Government of Canada to fulfill its obligations to First Nations by supporting and giving direction to work done for INAC and the First Nations through the GAPRI Program. This accord deals with First Nations Reserves, designated lands, surrendered lands, and any other lands held and administered by INAC for the use and benefit of First Nations. It will not apply to those First Nations who, by self-government legislation, may use land registries other than the ILR and the First Nations Land Register, or for dispositions made pursuant to the Indian Oil and Gas Regulations. The need to modernize Reserve land-management is driven by both the First Nations' evolving needs and by new legislation. Streamlined land-management activities would be more efficient, and require processes that identify and eliminate duplicated effort. Services to First Nations can be delivered in an effective, flexible, accessible and innovative manner under a variety of statutory regimes.

Development of the North

Canada's North is a vast and challenging region, home to many of Canada's Aboriginal people and endowed with a wealth of natural resources. Its extreme climate, widely dispersed population and limited infrastructure present challenges to improving the quality of life of northern Canadians. The Earth Sciences Sector is working to ensure that northern governments and communities have access to up-to-date information about the land, along with the modern technology and training they need to effectively manage their lands and improve their economic self-sufficiency. For more information, please see: http://ess.nrcan.gc.ca/pri/ndev_e.php.

Northern Resources Development

The Northern Resources Development Program will create and make accessible new, comprehensive mineral and energy geoscience products, such as regional data bases, maps and reports. These products will encourage development by raising private-sector awareness of investment opportunities in the North and reducing the risk inherent in exploration. Specific projects will help northerners build the knowledge and skills they need to help guide and participate in this development and better prepare them for employment opportunities in the exploration and development sector. For more information, please see: http://nrd.nrcan.gc.ca.

Mackenzie Delta, Northwest Territories

Geoscience in the Mackenzie Delta Region

Renewed hydrocarbon exploration in Canada's northern frontier regions has increased demands for updated geoscience information and interpretations to support exploration and development activities. ESS is applying modern quantitative basin-analysis techniques to identify the history of hydrocarbon generation, migration and accumulation for the Beaufort–Mackenzie Basin. The study addresses "big picture" questions that provide the context for the more detailed prospect-oriented work of exploration companies.

The study uses state-of-the-art analysis and modelling techniques, and provides key data and interpretations to companies for use in their day-to-day exploration decisions, thus promoting more efficient hydrocarbon exploration. Successful exploration will contribute to a safe and secure energy supply for Canadians and will promote economic development in the resource-dependent economies of northern Canada.

ESS Establishes Cultural Links with First Nations in Alberta and B.C.

ESS scientists have made important links with local First Nations in northern B.C. and northwestern Alberta through geomorphic and cultural connections. A member of the Dene Tha' band council in Chateh, Alberta, accompanied ESS scientists in the field. They shared insights into their cultural associations with the land and made geomorphic connections, such as observing that old wagon trails follow raised shorelines and crevasse-squeezed ridges. Plans are under way to engage more local First Nations through field trips aimed at the younger generations, and to provide the band council with GIS-based data for land-use planning. In northern B.C., ESS scientists have observed gas seeps, expressed as bubbles, coming to the surface of a lake. A local First Nations chief considered this as a reasonable explanation for a section of another lake not freezing throughout the winter. These cultural interactions are vital for enabling First Nations to participate in geoscience work, as well as demonstrating the long-term value of this work.

New Aeromagnetic Data Contribute to the Understanding of the Petroleum Prospectivity of Northern Baffin Bay

A collaborative research venture between the Geological Survey of Canada and the German Federal Institute for Geoscience and Natural Resources (BGR) has been successfully completed under the German–Canadian Agreement on Cooperation in Scientific Research and Technological Development.

With the assistance of the Polar Continental Shelf Project, GSC-Atlantic and BGR, scientists collected 9000 km of aeromagnetic data under challenging conditions in May and June over Nares Strait located at the southeastern end of Ellesmere Island. The new data significantly alter interpretation of the tectonic plate geometry between northern Canada and Greenland, with significant implications for the development of sedimentary basins in northern Baffin Bay and their petroleum prospectivity. This effort supports ESS's Northern Resource Development Program, and is the first field activity to be completed under the New Energy Options for Northerners Project (NEON).

An inukshuk stands guard, a powerful symbol of the North

Partnership in Alberta Highlights Diamond and Base-Metal Potential

In 2003, scientists from ESS and the Alberta Geological Survey released an interactive CD-ROM which includes maps and data pertaining to the potential for kimberlite-hosted diamond deposits, gold and base metals in southern Buffalo Head Hills, Alberta. The surficial materials maps and stream-sediment results have been well received by industry, who use this information as a framework for their exploration program planning. This work has led to an ongoing initiative in northern Alberta, with similar mapping and sampling strategies. ESS's collaborative, cost-sharing work with its provincial partner has stimulated new, and helped to expand existing, exploration by private industry in the area.

Geomatics for Northern Development

The Geomatics for Northern Development Program provides northern communities with spatially related information so they can make better and more efficient decisions, increase investment and promote land-based development in support of northern social and economic development. By providing geospatial information and knowledge, this program will stimulate resource exploration, and underpin infrastructure and land-use planning and capacity-building by local government and communities in the North. For more information, please see: http://gnd.nrcan.gc.ca.

Significant Progress Made in Mapping Nunavut

Since 2002, significant base mapping has been carried out in Nunavut. In December 2003, representatives of the Geomatics for Northern Development (GND) Program travelled to Nunavut to meet with government and agency representatives. They identified the fragility of network links and the pressing need for geospatial data on Nunavut as a key issue, and agreed to establish an information distribution service on site. In addition, GND representatives presented the results of their work to the managers of Nunavut's Department of Sustainable Development.

Jerry W. Heaps at his 1st Cartosat UN workshop in Ottawa, at Canada Map[illegible], manager of the Centre for Topographic Information - Ottawa.

Developing a Cartographic Development Index for Canada

Mapping a territory as vast as Canada represents a major challenge; one which is made more complex by the need to continually track progress. The Cartographic Development Index (CDI) is a standardized, reliable tool that can objectively measure progress, and a Canadian application is under development. The Geomatics for Northern Development and Geomatics for Sustainable Development of Natural Resources programs are working with the Department of Geography of the Université du Québec à Montréal on this project. Their main objective is to develop, adapt and apply a Cartographic Development Index specific to northern areas, which includes the entire Canadian landmass, using metadata taken from the ESS geospatial data bases.

ESS-Led National Initiatives

The GeoConnections Initiative

GeoConnections is a national partnership initiative to build the Canadian Geospatial Data Infrastructure (CGDI) and provide Canadians with easy access to geographic information over the Internet. The CGDI is helping Canada deal with a host of important challenges: environmental protection, disease and health surveillance, emergency preparedness and public safety, sustainable development, business growth, and municipal development and infrastructure creation, to name but a few.

GeoConnections encompasses seven programs: Access, Framework Data, GeoInnovations, GeoPartners, the Sustainable Communities Initiative, the Atlas of Canada, and GeoSkills. Each of these programs supports the development of the CGDI and Canadians' ability to access and use geographic information, applications and services. Through its GeoInnovations program, for example, GeoConnections provides funding to Canadian firms for the development of projects aimed at producing innovative and marketable geomatics technologies, applications and services for the CGDI. And through its Sustainable Communities Initiative, GeoConnections strengthens the capacity of Canada's rural, remote and Aboriginal communities to use geospatial information and GIS for their social and economic development.

GeoConnections is also a key part of the federal government's knowledge and innovation strategy, and the Connecting Canadians and Government On-Line agendas.

The following are a few examples of GeoConnections' activities in 2002–2004. For more information, please see: http://www.geoconnections.org/CGDI.cfm.

Supporting the Growth of Canadian Companies and Technologies

GeoInnovations issues requests for proposals that seek private-sector partners to develop specific geospatial applications, technologies and services for the CGDI. Some recent GeoInnovations projects include: the new Agent-based Link for Emergencies (ABLE) service, created over a two year period from 2001–2003, that will enable emergency management staff to retrieve and use geospatial data themselves simply and easily in times of crisis; the Smart Broker electronic brokerage service, established in 2003–2004, that can put together data packages for like-minded users within the CGDI, distributing the purchase costs among the data users and reducing the risks for data providers in producing the desired product; the Earth Analysis WorkBench (EAW) Project, completed in 2002, to give students and teachers on-line access to geomatics data, software and lesson plans that they can apply to a broad range of science projects; and in 2001–2002, the Emergency Services On-Line Dams (ESOL-Dams) framework of on-line services designed to support Canadian regulations for hydro-electric dam safety, which will integrate geomatics technologies, location-based GPS services, wireless communications, and data modelling, to enable officials to monitor and analyse the impact of water levels on populations and infrastructures within watersheds. For more information, please see: http://www.geoconnections.org/CGDI.cfm/fuseaction/home.welcome/gcs.cfm/geoinnovations/.

Emergency Response Workers Learn about Geospatial Data Support

At the 16th Emergency Preparedness Conference in Vancouver in October 2003, emergency response workers learned how geospatial data can support them during an emergency. GeoConnections and ESS's Natural Hazards and Emergency Response Program presented a joint plenary session that focused on geospatial data, tools and services for emergency management. Included were the GeoConnections activities associated with emergency response and disaster management. Opportunities for collaboration were discussed at follow-up meetings.

Protecting Critical Infrastructure Across Our Border

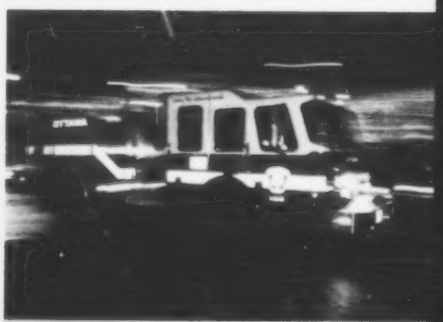
In April 2003, GeoConnections participated in a cross-border demonstration of the Critical Infrastructure Protection Initiative led by the Open GIS Consortium in Windsor, Ontario. The scenario was based on a transport truck carrying a noxious substance and involved Canadian and U.S. participants from all levels of government, first responders and local data providers. GeoConnections supported Canadian industry in testing Web-based tools and technology for exchanging geospatial data for emergency management.

Training Geomatics Professionals in Business Skills

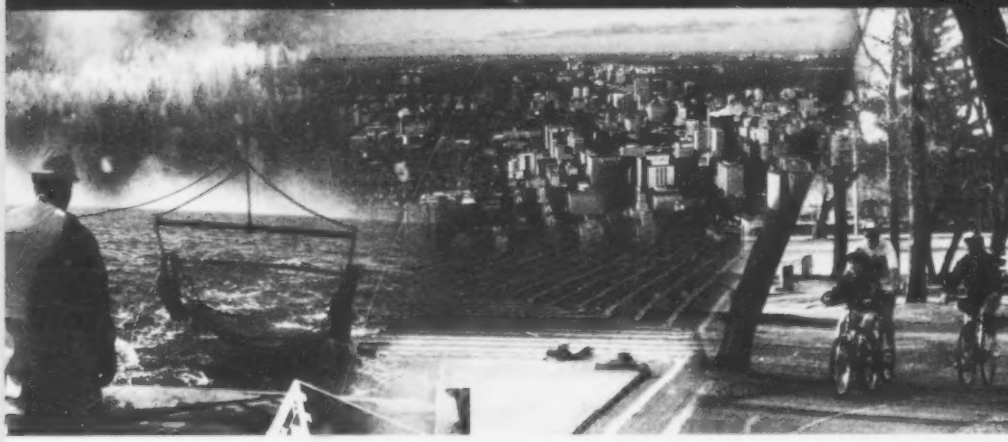
Geomatics professionals now have three new business courses tailor-made for them. The courses include writing winning geomatics proposals, managing geomatics projects for results and closing more geomatics sales. GeoConnections' GeoSkills program developed the courses in partnership with the Canadian Institute of Geomatics, the Canadian Council of Lands Surveyors and the Geomatics Industry Association of Canada, who provide the training and deliver the courses. Pilot seminars were held in late 2003, with training offered in the spring of 2004 in conjunction with various geomatics-related conferences. Colleges and universities can request the training materials free of charge to deliver to their students.

New Atlas Frameworks Available for Sustainable Development

Four new national framework data sets that integrate human and environmental frameworks became available in June 2003. The data sets depict watersheds/hydrology, road and rail networks, and populated places at a scale of 1:1M. The Atlas of Canada, Environment Canada, Statistics Canada, NRCan and the GeoConnections initiative were partners on the project. For more information, please see: http://geogratis.gc.ca.



The Climate Change Impacts and Adaptations Program



The Climate Change Impacts and Adaptation Program's main objective is to improve knowledge of Canada's vulnerability to climate change, to better assess the risks and benefits posed by a changing climate, and to build the foundation upon which appropriate decisions on adaptation can be made. The program supports research to fill critical gaps that limit knowledge of vulnerability, undertakes and supports assessment of impacts and adaptation, enhances collaboration between stakeholders and researchers and facilitates policy development. For more information, please see: http://www.adaptation.nrcan.gc.ca/.

Funding Research to Understanding Climate Change Impacts

In 2002–2003, 31 new research projects were funded in water resources, human health, coastal zone, forestry, transportation, tourism and recreation focusing on the processes, barriers and drivers of adaptation. Many of these three-year projects are the first in Canada to examine the implications of climate change on food security in northern Aboriginal communities; the linkage between increased forest fires and respiratory ailments; and the role of current forest-management policies and legislation in adaptation. Key findings from five years of research have been summarized in *Climate Change Impacts and Adaptation: A Canadian Perspective*. The report is available on line at: http://www.adaptation.nrcan.gc.ca/perspective_e.asp.

Climate Change Policy Coordination and Networking

As part of a federal/provincial/territorial working group, ESS was instrumental in the development of the National Adaptation Framework, whose elements were agreed to by the Joint Ministers of Energy and Environment in 2002. The Canadian Climate Impacts and Adaptation Research Network (C-CIARN), created in 2000, brings together the impacts and adaptation research community with stakeholders. University and government partners host 13 regional and sectoral coordinating offices, and have sponsored more than 25 workshops attracting 2350 network members. For more information, please see: http://www.c-ciarn.ca/index_e.asp.

Polar Continental Shelf Project

Polar Continental Shelf Project (PCSP) was created in 1958 to help Canada establish and subsequently maintain its sovereignty in the Arctic through peaceful means. Over the years, PCSP has gained a worldwide reputation for logistics efficiency and cost-effectiveness in helping thousands of scientists to learn about a region covering 40% of Canada's landmass and offshore. In the 2003 federal budget, the Government of Canada provided PCSP with additional funding to extend additional logistics support to Arctic research programs related to northerners' health, sustainable development and the environment. For more information, please see: http://polar.nrcan.gc.ca.

Photograph: Polar Continental Shelf Project

PSCP Strengthens Traditional Knowledge in the North

Through its Traditional Knowledge Program, PCSP provides support to northern community-based cultural programs designed to capture and transfer the oral history, traditional hunting and fishing, and other skills and knowledge from Aboriginal elders to younger generations. Groups from Igloolik, Tuktoyaktuk and Cambridge Bay received support through this program in 2002 and 2003.

Photograph: Polar Continental Shelf Project

Arctic Support for the Antarctic Treaty

PCSP lends substance to Canada's role as an Antarctic Treaty member through delivery of the Canadian Arctic–Antarctic Exchange Program. PCSP supports Antarctic researchers working in Canadian research programs in the Arctic, while the Canadian partners are supported by their Antarctic colleagues to work in their field programs in the South Polar region. Recent exchanges involved U.S., New Zealand and Bulgarian scientists.

PCSP is Canada's representative on the Council of Managers of National Antarctic Programs, which has linkages to the equivalent Arctic logistics group, the Forum of Arctic Research Operators. Both these logistics networks are working with the international polar research community in planning for International Polar Year in 2007.

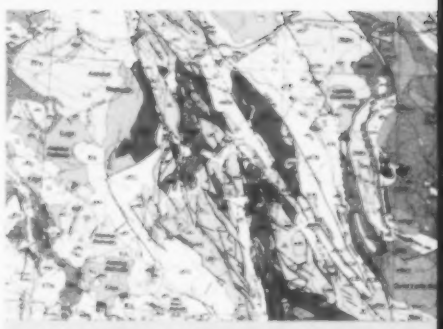
Comparing Earth to Mars

NASA Ames Research Center in the United States is working with Canadian researchers and scientists from other countries to study the Haughton meteorite impact crater on Devon Island, Nunavut, as a possible "analog" site for Mars. Scientists are studying the similarities and differences between Earth and Mars, with particular attention to the role of water in shaping the landscape and supporting life. As well, they are investigating new technologies and strategies for the future exploration of Mars (and possibly the Moon) by robots and humans. For more information, please see: http://www.marsonearth.org.

Awards

Bob Turner and **John Clague (GSC)** received the Geological Association of Canada's Ward Neale Medal in May 2002 for excellence and leadership in geoscience education and outreach for their work on Geoscape/Geomap posters.

John Wheeler (GSC) received the 2002 Massey Medal from the Royal Canadian Geographic Society for outstanding achievement in the field of Canadian geography. Mr. Wheeler is an emeritus research scientist, a mountain mapper whose accomplishments include surveying the geology of 100 000 square kilometres of western Canada.



The **GSC's Bedrock Geology of the Yukon Territory map** was selected to be one of the 24 maps included in the *2002 Map Book* of Environmental Systems Research Institute Inc. (ESRI). There were more than 600 submissions. GSC authors **Steve Gordey** and **Andrew Makepeace** received a Sector Merit Award for their accomplishments.

Dr. Roy Hyndman (GSC) was elected a Fellow of the American Geophysical Union (AGU), and received the Fellow's certificate during the Honours ceremony in May 2004 for his eminence in geophysics.

Dr. Herb Dragert (GSC) was invited to present the William Bowie Lecture to the American Geophysical Union at their fall meeting. This honour recognized the work of Dr. Dragert and his team on episodic tremor and slip carried out under ESS's Natural Hazards and Emergency Response Program.

Dr. Fari Goodarzi (GSC) received the Canadian Society of Coal Science and Organic Petrology's Hacquebard Award in September 2002. The award recognized Dr. Goodarzi's commitment to teaching, and his research in the areas of pure and applied coal and organic petrology and environmental geochemistry.

In January 2003, **Kirk Osadetz (GSC)** was awarded the 2002 Tracks Award by the Canadian Society of Petroleum Geologists (CSPG) for his long-time support to the Society. Mr. Osadetz had assembled the best oral and poster program at the 2002 Jubilee CSPG Convention, and served as Associate Editor of the *Bulletin of Canadian Petroleum Geology*.

Also at the CSPG, **Dr. Ashton Embry (GSC)** received the prestigious 2002 Link Award for his presentation on methods of sequence stratigraphic analysis, an important aspect of petroleum exploration. The award also recognized Dr. Embry's long association and interaction with the petroleum industry.

In April 2003, **Dr. Grant Mossop (GSC)** received the 2003 National Managers' Community Leadership Award for his successive tenures as Director of the Alberta Geological Survey and the Geological Survey of Canada (Calgary).

Polar Continental Shelf Project was the 2003 recipient of the prestigious International Canvasback Award, presented by the North American Waterfowl Management Plan (NAWMP), which honours organizations that have made a significant international contribution toward achieving its waterfowl and wetland conservation goals. The award, named after the canvasback duck, is the highest honour awarded by NAWMP, considered one of the most successful international conservation initiatives in the world.

Yves Mireault won a Natural Resources Canada Award in the spring of 2003 for his "Strategy for Locating Global Positioning System (GPS) Satellites," which estimates the predicted precise orbit of GPS satellites in near-real time using data from the International GPS Service (IGS). Mr. Mireault's dedication has earned NRCan a reputation as one of the world's leading centres in near-real time precise GPS orbit estimation and prediction.

The **Canada-wide Differential GPS (CDGPS) project** won sector, departmental and provincial awards for offering Canadians access to accurate and reliable positioning linked to the national standard in real time. In September 2003, it won a "Showcase Ontario" Diamond Award in a combined submission from Ontario's Ministry of Natural Resources under the category of "Serving Ontario Citizens Better." Following this in March 2004, ESS's CDGPS Launch team won a Natural Resources Canada award for bringing NRCan's world-class prototype to full and continuous operation, as all ten provinces and Nunavut are delivering NRCan's GPS corrections. The team members are: Norman Beck, Mark Caissy, Steve Delahunt, Brian Donohue, Ray Fong (contractor), Gordon Garrard, Pierre Héroux, François Lahaye, Kim Lochhead, Pierre Mathieu, Ken MacLeod and Yves Mireault.

Canada's National Gravity Team was awarded a Natural Resources Canada Award in March 2004 for establishing a Gravity display at the Canada Science and Technology Museum to commemorate the centenary of Canadian gravity observations. The team members are Carey Gagnon, Bryne Hearty, John Halpenny, Joe Henton, Diane Jobin, Calvin Klatt and Jacques Liard.

In June 2003, the **Mapping for Visually Impaired team** in the Mapping Services Branch won the Association of Professional Executives of the Public Service of Canada (APEX) Award for Leadership in Service Innovation, sponsored by Deloitte Consulting.

The members of the **regional hydrogeology team** working on the fractured aquifers of southwestern Quebec and led by Martine Savard received the Head of the Public Service Award in recognition not only of the excellence of their scientific work, but also of their professionalism and the care they always take to make information accessible to local and regional decision-makers.

Public Outreach

Geoscience Education Conference an International Success

Godfrey Nowlan (GSC-Calgary) chaired the Organizing Committee for GeoSciEd IV, the fourth International Geoscience Education Conference of the International Geoscience Education Organization held in August 2003. The five-day conference was a huge success, attracting 270 delegates from 26 countries. Participants remarked on the quality of both the organization and the presentations. The keynote speeches were highly regarded and the field excursions were a particular highlight. GeoSciEd Conferences are held every three or four years and are the major international forum for geoscience education.

GSC Project Among Top Ten Scientific Discoveries of 2002

A GSC project, carried out under the ESS Metals in the Environment (MITE) Program, was named by *Québec Science* magazine as one of the top ten scientific discoveries of 2002. A jury of science journalists selected this discovery from about 30 research initiatives at Quebec universities and science institutes. The article presents the conclusions of the project, which found that concentrations in boreal forests of potentially toxic substances, such as sulphur dioxide emitted by smelters, greatly diminish CO_2 intake by trees. It would seem, therefore, that the forest needs cleaner air in order to help reduce the greenhouse effect and to fully discharge its role as a carbon sink and capture carbon dioxide.

ESS Activities during National Science and Technology Week

ESS has led National Science and Technology Week (NSTW) activities for NRCan for more than ten years. In the National Capital Region, the 2003 "Science Funfest" attracted more than 3500 visitors to 55 exhibits. With participation from other government departments, such as Agriculture and Agri-Food Canada, the Department of Fisheries and Oceans, and Health Canada, it was truly a Government of Canada event. Scientific presentations were given to some 750 students and teachers during the week, which provided an opportunity to put the spotlight on NRCan's science and technology programs — showing not only their impact and relevance to everyday life in Canada, but also how interesting and fun S&T can be. The success of the events was due to the enthusiasm and commitment of staff who volunteer their time for NSTW events.

As part of a regional NSTW activity, 19 secondary-school teachers took part in an interpretive geology excursion in the Québec region. The excursion was designed to tie in with the *Geoscape Québec* poster. The one-day excursion through Old Québec and the Montmorency Falls tourism and recreation site linked geological concepts to the region's natural and historic heritage and to dramatic events of the past, such as earthquakes and landslides, that are occasionally echoed in the current-day life of the region.

Dr. Susan Ritz, Associate Assistant Deputy Minister, ESS, takes a look at the Climate Explorer during the launch of Natural Science and Technology Week.

Mount Logan, Yukon Territory, Photograph: GS Wahl

Travelling Climate Change Show Reaches Out to Canadians

A Climate Change Show is on a five-year, cross-country tour to inform and educate Canadians about the impact of a changing climate and how to adapt to it. Natural Resources Canada and the Canadian Association of Science Centres collaborated on the show. Its centrepiece is the Climate Explorer, a computer interactive system housed in a helicopter shell, that teaches visitors about climate change through Mt. Logan ice cores, information on forest fires, bio-fuels and lightweight metals. The show opened at the Museum of Science and Technology in Ottawa in November 2003 for a three-month stay before leaving for Iqaluit, Nunavut. It is expected to reach more than one million Canadian citizens during its five-year tour among participating science centres.

Mt. Logan Ice-Core Science Highlighted in Outreach Activities

In 2001, ESS led an expedition to extract ice cores from Mt. Logan that included scientists from Canada, the United States and Japan. In November 2003, some of the scientific highlights from the two-year expedition were presented in popular lectures in Whitehorse, organized by the Yukon Science Institute, and at the Kluane National Park visitor centre in Haines Junction, organized by Parks Canada. As well, the Canadian Museum of Nature is producing a multi-media, interactive exhibition to demonstrate the relevance of these ice-core samples to Canadians. These outreach efforts showcase how paleo-climate data are being used to reconstruct past climates for climate-change impact analysis.

Twenty Students Receive Canadian Geomatics Scholarships

In 2003, 20 post-secondary students were awarded scholarships under the Geomatics Canada scholarship program to pursue further studies in Canada. The scholarship program is funded jointly by the GeoSkills Program of GeoConnections and Geomatics Canada, and administered by the Canadian Institute of Geomatics. GeoSkills' objectives are to strengthen the capacity and competitiveness of Canada's growing geomatics sector, help graduates gain the skills that geomatics employers want and promote geomatics as a career choice. A list of the 2003 scholarship winners is posted at: http://www.cig-acsg.ca/page.asp?IntNodeID=25.

Marking the Centennial of Canadian Gravity Observations

ESS provides the national standard of reference for observations of gravity. Gravity measurements help us find our subterranean natural resources, define our Continental Shelf, determine the satellite positions needed for air traffic and detect the slow creep of the Earth's crust that may presage the next earthquake on the West Coast. In 2003, ESS partnered with the Canada Museum of Science and Technology to mount a special exhibit commemorating a century of Canadian gravity measurements. An estimated 150 000 visitors learned how ESS maintains our national gravity standards through a display of complex instrumentation, accompanied by storyboards and brought to life by ESS staff, who volunteered their time. The Dominion Observatory performed the first gravity observations, and today the Canadian Geodetic Service is responsible for the national gravity reference frame.

Community Outreach Activities in Northern British Columbia

British Columbians are learning more about geoscience from a community outreach initiative in northern B.C. ESS scientists, connected by *Science in the Centres*, partnered with staff of The Exploration Place, a science centre in Prince George, and with teachers from northern B.C. communities. Together, they are producing a suite of products that focus on energy resources. Of particular interest is the northeastern area of B.C., a site of considerable production, and the Bowser Basin and offshore west coast, two areas with the potential for energy resources. The products will lead to exhibits at The Exploration Place and will also go into a portable "science box" that can travel to schools across the region.

Sector Representation at a Meet-the-Media Event

In February 2002, a network of 24 federal research and development organizations in Quebec organized the first science communication gathering of federal researchers, information professionals and members of the media. This media outreach event was held at the Montréal Science Centre under the theme "A Universe to Discover!" It brought together some 60 federal researchers and numerous science communicators with the aim of bringing federal research to greater public attention.

Earth Sciences Sector Across Canada

Earth Sciences Sector Across Canada

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Contact information for the GSC Regional Offices is as follows:

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Dartmouth, N.S.: Telephone (902) 426-3225, fax (902) 426-1466 or e-mail info-dartmouth@gsc.nrcan.gc.ca

Québec City: Telephone (418) 654-2604, fax (418) 654-2615 or e-mail info-stefoy@gsc.nrcan.gc.ca

Sidney, B.C.: Telephone (250) 363-6500, fax (250) 363-6565 or e-mail info-sidney@gsc.nrcan.gc.ca

Vancouver: Telephone (604) 666-0529, fax (604) 666-1124 or e-mail info-vancouver@gsc.nrcan.gc.ca

Contact information for the GSC Regional Libraries is as follows:

Calgary: Telephone (403) 292-7165, fax (403) 292-5377 or e-mail calgary.ref@gsc.nrcan.gc.ca

Dartmouth, N.S.: Telephone (902) 426-3683, fax (902) 496-1544 or e-mail biolibrary@mar.dfo-mpo.gc.ca

Québec City: Telephone (418) 654-2677, fax (418) 654-2615 or e-mail gscq_library@nrcan.gc.ca

Sidney, B.C.: Telephone (250) 363-6392, fax (250) 363-6749 or e-mail paclibrary@dfo-mpo.gc.ca

Vancouver: Telephone (604) 666-3812, fax (604) 666-7186 or e-mail libvan@gsc.nrcan.gc.ca

Contact information for the Map and Publications Sales Offices is as follows:

Calgary: Telephone (403) 292-7030, fax (403) 299-3542 or e-mail gsc_calgary@gsc.nrcan.gc.ca

Dartmouth, N.S.: Telephone (902) 426-4386 or fax (902) 426-4848

Québec City: Telephone (418) 654-2677, fax (418) 654-2615 or e-mail sdupuis@nrcan.gc.ca

Sidney, B.C.: Telephone (604) 666-0271, fax (604) 666-1337 or e-mail gscvan@gsc.nrcan.gc.ca

Vancouver: Telephone (604) 666-0271, fax (604) 666-1337 or e-mail gscvan@gsc.nrcan.gc.ca

Contact information for the Legal Surveys Division Offices is as follows:

Amherst, N.S.: Telephone (902) 661-6766, fax (902) 661-6769

Québec: Telephone (418) 648-5725, fax (418) 648-5728

Toronto: Telephone (416) 973-1006, fax (416) 973-1004

Winnipeg: Telephone (204) 983-3793, fax (204) 983-0157

Regina: Telephone (306) 780-5402, fax (306) 780-5191

Edmonton: Telephone (780) 495-2496, fax (780) 495-4052

Vancouver: Telephone (604) 666-5313, fax (604) 666-0522

Whitehorse: Telephone (867) 667-3950, fax (867) 393-6709

Yellowknife: Telephone (867) 669-3949, fax (867) 920-6662

Iqaluit: Telephone (867) 975-6601, fax (867) 975-6624

Contact information for the Centre for Topographic Information - Sherbrooke

Sherbrooke: Telephone (819) 564-5600 or 1-800-661-2638, fax (819) 564-5698 or e-mail NTDB@NRCan.gc.ca